Polarized Electron Sources for a Linac-Ring Electron-Ion Collider

M. Farkhondeh

MIT-Bates Linear Accelerator Center
P.O.Box 849, Middleton, MA 01049, USA

Abstract

A polarized electron source which could meet the requirements of a linac-ring electron-ion collider (EIC) is very challenging. The necessary highly polarized average current, 100-200 mA, is about three orders of magnitude above what is produced today. At this point, the only practical method of producing high currents with a high degree of polarization is photoemission from negative electron affinity GaAs based photocathodes. Higher average currents may be achieved by a combination of increased laser power and/or higher quantum efficiencies of the photocathode. Higher degrees of polarization are routinely obtained when the four-fold degeneracy of the valance band is broken by adding uniaxial strain or super lattice structures. Quantum efficiency lifetimes at high average currents for existing polarized sources are primarily limited by ion back bombardment of the photocathodes, which is a function of the vacuum condition in the gun. For the EIC currents, excellent UHV vacuum conditions approaching XHV (Extreme High Vacuum) will be required. A laser system with the RF structure of EIC and sufficient power does not exist today and R&D will be required to develop such a laser. An attractive alternative may be the use of a CW high power fiber coupled diode array laser system that exists today. The 28 MHz microstructure must then be introduced to the electron beam using chopping and bunching with accelerating structures. Highly polarized beams with peak currents of about 100 mA and duty factors of 1% have been produced on a test setup at MIT-Bates. The parameters of a polarized electron source with the two laser options for a linac-ring EIC will be presented.